AN INVESTIGATION OF TIME VARIABILITY IN WATER-LEAVING RADIANCES RETRIEVED FROM OCEAN COLOR MEASUREMENTS

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I. INTRODUCTION AND RATIONALE

As part of the calibration/validation effort performed on data from the Ocean Color and Temperature Scanner (OCTS) aboard the Advanced Earth Observing Satellite (ADEOS-I) spacecraft by the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Project, a time series of averaged normalized water-leaving radiances derived from 27 scenes centered in the Sargasso Sea was generated and compared to nominal water-leaving radiances derived from the Marine Optical Buoy (MOBY) *in situ* data site and to a time series from one year later in the same area created from NASA's Sea-viewing Wide Field-of-view Sensor (SeaWiFS). Due to the small number of usable match-up *in situ* data in existence, additional validation of the SIMIBOS OCTS calibration was sought. The Sargasso Sea area was chosen because it yielded the largest number of clear-water scenes within the OCTS data set in the possession of the SIMBIOS project.

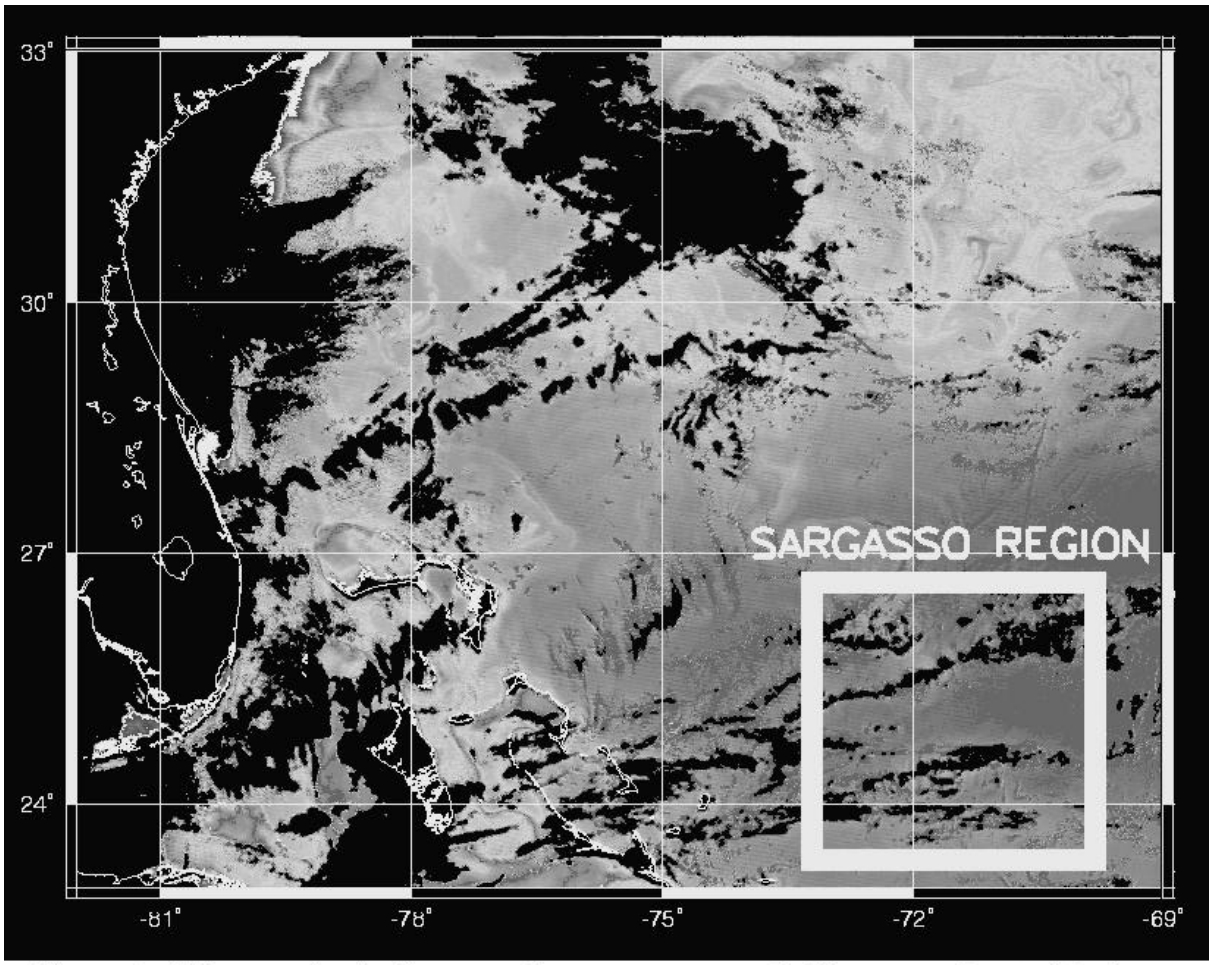

Figure 1: 27 scenes in the Sargasso Sea area were used. They were located in the 3-degree square box between Latitudes 23.5° and 26.5° and Longitudes -73° and -70°. The time range encompassed is from 19 November 1996 to 20 May 1997.

II. SIMBIOS PROCESSING METHODS

OCTS DATA were selected from approximately 350 East Coast North America and Alaskan scenes of OCTS ILAC data (1-km resolution) obtained by NASA/GSFC from a direct downlink to Wallops Island, Virginia during the duration of the OCTS mission. All software and algorithms used for Level 0 to Level 1B and Level 1B to Level 2 processing were independently developed by the SIMBIOS team. **Level 0 to Level 1B Processing** uses a nearest neighbor band co-registration algorithm similar but not identical to that used in the standard NASDA software and applies NASDA's pre-launch calibration. The band-dependent viewing geometry is carried through to the Level 2 processing. **Level 1B to Level 2 Processing** uses an atmospheric correction algorithm based on the SeaWiFS algorithms of Howard Gordon and Menghua Wang. Bands 7 and 8 are used for identification of aerosol type, in contrast to the band 6/band 8 algorithm employed by NASDA. The OCTS calibration was rederived using the SIMBIOS atmospheric correction algorithm and *in situ* measurements from the MOBY sensor, with band 8 fixed at the NASDA Version 4 value. The resulting calibration tuning factors for bands 1-7 (Table 1) represent a completely independent assessment of the OCTS sensor calibration and are in good agreement with the NASDA Version 4 values.

OCTS BAND (nm)	1 (412)	2 (443)	3 (490)	4 (520)	5 (565)	6 (670)	7 (765)	8 (865)
NASDA VERSION 4	1.14	1.03	0.9394	1	1.04	1	1.02	0.89
SIMBIOS	1.12657	1.01735	0.94608	1.00108	1.02529	0.99	0.910659	0.89

Table 1: Gain adjustment coefficients obtained from match of OCTS data with MOBY *in situ* data.

OPTIMAL CLEAR-WATER RADIANCES were derived from MOBY *in situ* data tuned to the OCTS and SeaWiFS wavelengths respectively (See Tables 2 and 3).

OCTS BAND (nm)	1 (412)	2 (443)	3 (490)	4 (520)	5 (565)	6 (670)
Optimal nLw (mW/cm^2/μm/sr)	1.61	1.45	1.03	0.49	0.19	0.009

Table 2: Optimal clear-water normalized radiances for OCTS derived from MOBY *in situ* data.

SeaWiFS BAND (nm)	1 (412)	2 (443)	3 (490)	4 (510)	5 (555)	6 (670)
Optimal nLw (mW/cm^2/μm/sr)	1.68	1.47	1.01	0.60	0.26	0.02

Table 3: Optimal clear-water normalized radiances for SeaWiFS derived from MOBY *in situ* data.

SEAWIFS 8-DAY TIME-BINNED DATA was generated for a 3-degree box centered at Latitude 25.5° and Longitude -71.5° for 26 8-day periods between November 1997 and May 1998. The SeaWiFS time binning procedure averages all acceptable values over each time period on a pixel-by-pixel basis.

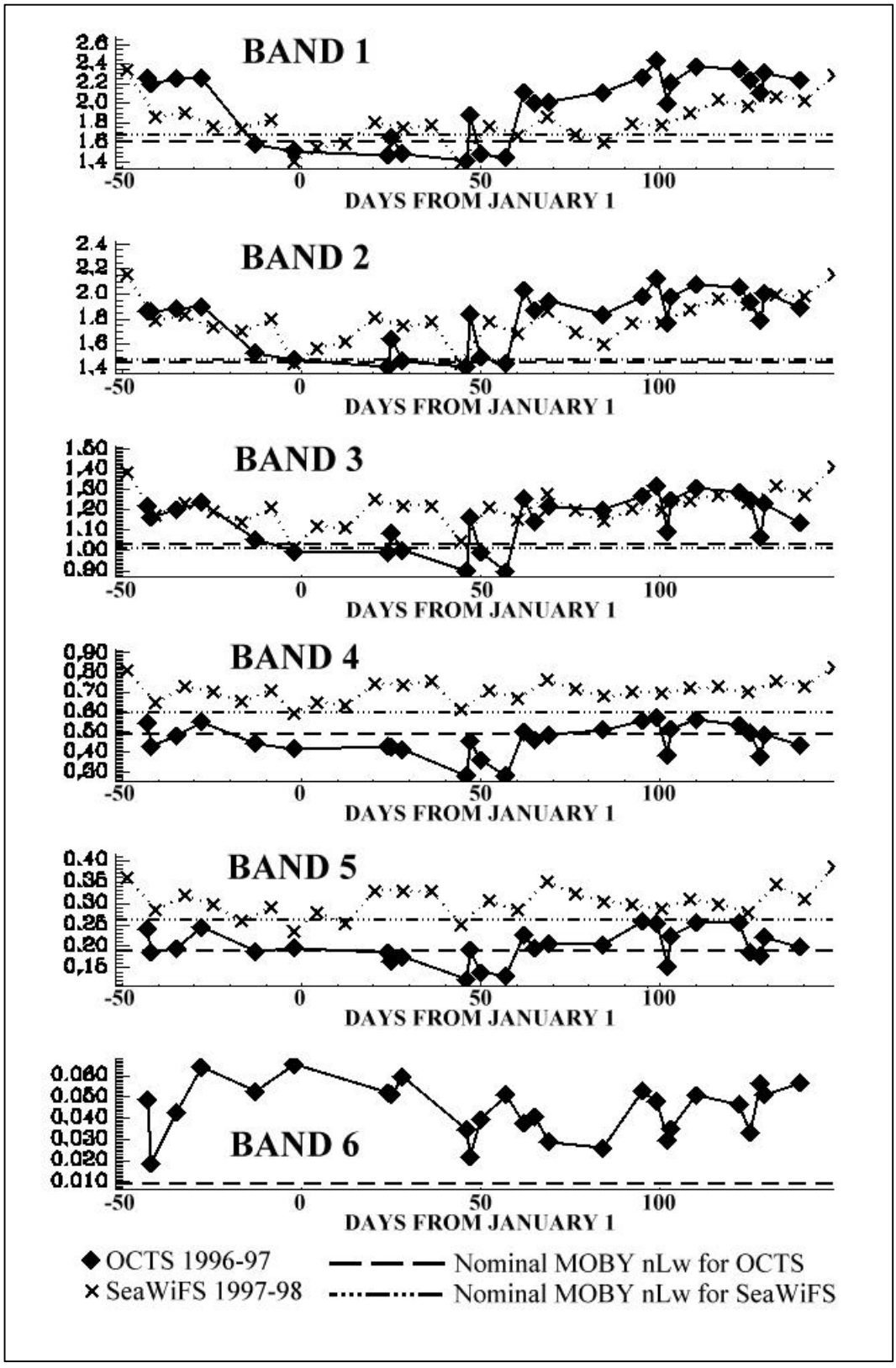

Figure 2: Comparison of OCTS 1996-1997 and SeaWiFS 1997-1998 normalized water-leaving radiances (nLw's) in the Sargasso Sea. Optimal MOBY-derived nLw values are indicated on each graph. Note that for Bands 4 and 5, the OCTS and SeaWiFS wavelengths differ by 10 nm (see Tables 2 and 3). Units are $mW/cm^2/\mu m/sr$.

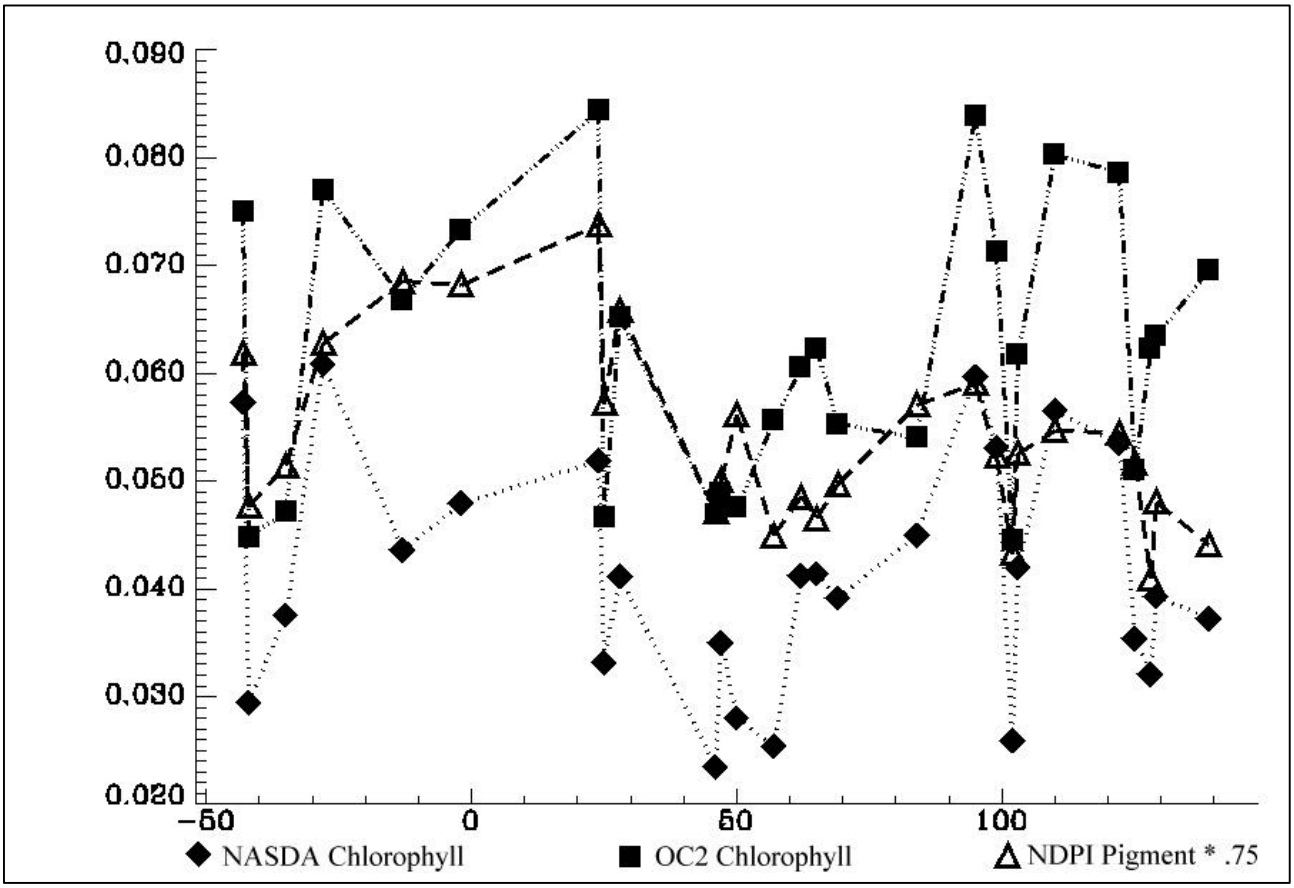

Figure 3: Chlorophyll and NDPI Pigment computed from averages of nLw's for 27 Sargasso Sea scenes from OCTS data. Note that NDPI pigment has been multiplied by .75.

III. STATISTICAL ANALYSIS PERFORMED

Normalized water-leaving radiances (nLw's) were averaged over each scene (excluding values where chlorophyll was not within acceptable limits, *i.e.* between .0005 μg/L and .30 μg/L) and nLw and chlorophyll distributions were computed. Averaged nLw values were compared to nominal MOBY-derived values and to SeaWiFS values from one year later. Chlorophyll values for the OC2 (tuned to OCTS) and OCTS-C chlorophyll algorithms (denoted as "NASDA Chlorophyll" in Figure 3) were computed from the averaged nLw's as was NDPI pigment.

IV. ANALYSIS AND CONCLUSIONS

The agreement in the general behavior of the OCTS data and the SeaWiFS data from one year later suggest that the variability seen in the Sargasso Sea nLw values is due to seasonal variation rather than instrument instability. Values of OCTS averaged nLw's agree reasonably well with MOBY-derived nominal nLw's and show that our calibration is working well. The three chlorophyll algorithms used on OCTS data agree in the average (see Figure 3) but the distribution of the chlorophyll derived by the OC2 algorithm is somewhat broader than that obtained using the NASDA chlorophyll or NDPI pigment algorithm (see Figure 4).

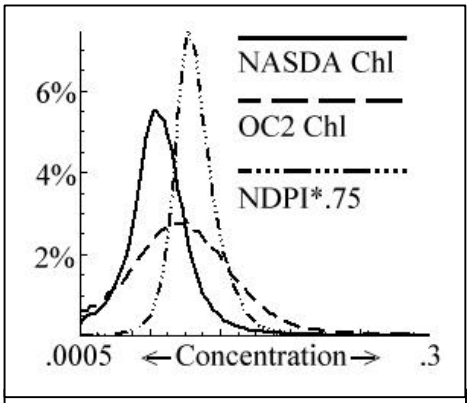

Figure 4: Normalized histograms of chlorophyll and NDPI Pigment (*.75) concentrations on February 17, 1997. The pattern displayed is typical.